

Name _____

- How much heat (in J) is needed to warm 0.250 kg of water (about 1 cup) from 22°C (about room temperature) to near its boiling point, 98°C? **Circle the correct answer.** $s_{\text{H}_2\text{O}} = 4.184 \text{ J/g}\cdot^\circ\text{C}$ [3 pts]
a) -79.5 J b) $7.95 \times 10^4 \text{ J}$ c) 79.5 J d) $2.30 \times 10^4 \text{ J}$ e) $-7.95 \times 10^4 \text{ J}$

- A 12.0 g sample of an unknown metal is heated to 91.0°C and is placed in a perfectly insulated container along with 154 g of water at an initial temperature of 21.45°C. After a short time the temperature of both the metal and water become equal at 24.65°C. The specific heat of water is 4.184 J/g·°C in this temperature range. What is the **specific heat, s** , of the metal? [4 pts]

- True or False**
 - Blue light has a higher frequency than red light. [1 pt]
 - X-rays have a shorter wavelength compared to radio waves. [1 pt]

- What is the **frequency** of an electromagnetic wave, the wavelength of which is $8.8 \times 10^{-8} \text{ m}$? **Circle the correct answer.** [3 pts]
a) $2.3 \times 10^{-18} \text{ Hz}$ b) $2.3 \times 10^{-16} \text{ Hz}$ c) 26 Hz d) $3.4 \times 10^{15} \text{ Hz}$ e) $2.9 \times 10^{16} \text{ Hz}$

- How much **energy** (in joules) is contained in one mole of photons of frequency $3.3 \times 10^{13} \text{ Hz}$? **Circle the correct answer.** [3 pts]
a) $2.2 \times 10^{-20} \text{ J/mol}$ b) $3.6 \times 10^{-15} \text{ J/mol}$ c) 61 J/mol
d) $1.3 \times 10^4 \text{ J/mol}$ e) $1.8 \times 10^{10} \text{ J/mol}$

6. **True or False.** When an electron in an (unbound) hydrogen atom [H(g)] is excited from the ground state to the $n = 3$ state:
- The electron is closer to the nucleus on average in the $n = 3$ state than in the ground state. [1 pt]
 - The first excited state corresponds to $n = 3$. [1 pt]
 - The wavelength of light emitted when the electron drops from $n = 3$ to $n = 2$ is longer than the wavelength of light emitted if the electron falls from $n = 3$ to $n = 1$. [1 pt]
 - The wavelength of the light emitted when the electron returns to the ground state from $n = 3$ is the same as the wavelength of light absorbed to go from $n = 1$ to $n = 3$. [1 pt]

7. The energy (in joules) of an electron energy level in the Bohr atom is given by the expression:

$$E_n = -2.18 \times 10^{-18} \text{ J} \left(\frac{1}{n^2} \right) \text{ where } n \text{ is the principal quantum number for the energy level.}$$

- Calculate the **energy** (in J) of both the 3rd energy level and the 7th energy level in a hydrogen atom? [3 pts]
- Calculate ΔE between the 3rd and 7th energy levels in the hydrogen atom. [2 pts]
- What is the **wavelength** of the photon necessary to promote an electron from $n = 3$ to $n = 7$ in a hydrogen atom? [2 pts]

Potentially Useful Information

$$q = ms\Delta T$$

$$\Delta T = T_f - T_i$$

$$s_{\text{H}_2\text{O}} = 4.184 \text{ J/g}\cdot^\circ\text{C}$$

$$c = \lambda\nu$$

$$E = h\nu$$

$$E = \frac{hc}{\lambda}$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$E_n = -R_{\text{H}} \left(\frac{1}{n^2} \right)$$

$$R_{\text{H}} = 2.18 \times 10^{-18} \text{ J}$$

$$\Delta E = E_f - E_i$$